A Study On Mechanical And Dynamic Characteristics Of Rubberized Concrete Using Crumb Rubber

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Abstract: **Cement Concrete is most widely used material for various constructions. Increased use of various ingredients of concrete for construction works has lead to the immense scarcity of natural materials like sand, stone etc. Added to this, in the recent past, growing environmental problem due to excess production of solid waste materials like fly ash and silica fume has tempted many researchers to try these materials as concrete ingredients. Also, the disposal of used tyres has become a tough task. Therefore, in this paper, it is proposed to investigate the effect of crumb rubber on strength characteristics of Ordinary Portland Cement (OPC) Concrete and Ternary Blended Concrete (TBC) of M40 grade with fly ash and silica fume as powders along with cement. The mechanical properties of TBC in fresh and hardened state are studied and compared with that of OPC Concrete.**

Keywords: **Crumb Rubber; Fly Ash; Silica Fume; Ternary Blended Concrete; Mechanical Properties; Impact Strength;**

I. INTRODUCTION

Solid waste management has been a major environmental concern in cities around the globe. Recent studies indicate that roughly 4.6 billion tons of nonhazardous solid waste materials are produced annually in the United States among which waste tyres constitute a significant portion. It was predicted that approximately 400 million waste vehicle tyres were collected in India by the end of the year 2009. Wasted or abandoned tyres are not easy to decompose. The simplest way to get rid them is by burning, but this method generates many problems and pollution due to smoke. Therefore, the burning method is unacceptable and in some countries it is prohibited by law. An easier solution is to leave them piling up on empty lands, which indirectly generates several other problems because they simply turn into fire sources or insect and animal habitat. Because of the above problems, more and more attention has been paid to use waste vehicle tyres in Portland cement concrete as waste aggregate. As concrete has become the most widely used construction material in the world, the partial addition of rubber tyre particles into concrete would consume billions of scrap tyres. Moreover, the use of rubber tyres in concrete could improve the ductility and toughness of the material apart from providing a permanent solution for disposal of this waste material. Therefore, successful use of the material in concrete could not only provide a promising solution to the environmental problem, but also gives us a material with some improved properties due to its high energy absorption characteristics.

The present work aims at the study of impact of crumb rubber on the mechanical properties of TBC in fresh and hardened state and to compare the same with the OPC concrete. Fly ash and silica fume are used in TBC as partial replacement of cement. It is known from the literature that the introduction of crumb rubber in concrete improves energy absorption characteristics of OPC concrete. Hence, in the present study, crumb rubber powder is used in TBC to improve energy absorption characteristics of concrete. Thus, by using fly ash, silica fume and crumb rubber in concrete, environmental problem of disposal of these waste materials can be solved to some extent**.**

II. METHODOLOGY

Eight batches of concrete were cast of which four batches is made of M40 grade using crumb rubber with various percentages (0%, 5%, 10% and 15%) and remaining four batches were made of M40 grade ternary blended concrete with various percentages of crumb rubber (0%, 5%, 10% and 15%). Optimum percentages of silica fume and fly ash in ternary blended concrete were obtained by making number of trials starting from 5% silica fume and 15% of fly as partial replacement of cement. Optimum mix was arrived at by considering the compressive strength. Six cubes, three cylinders, three prisms and three discs were cast corresponding to each batch of concrete to determine the compressive, tensile, flexural and impact strengths of concrete. Cylindrical discs with 150 mm diameter and an average depth of 63 mm were tested for Impact strength. The test was carried out according to ACI: 544.

Workability and Density:

The workability of TBC is found to be more compared to OPC concrete for all percentages of

crumb rubber content. There is a decrease in workability of concrete as percentage of crumb rubber increased from 0% to 15% in OPC concrete as well as TBC. However, the workability is more in TBC compared to OPC concrete. The density of concrete also decreased as the crumb rubber content increased due to the fact that its density is very less. But the reduction in density is more in OPC concrete than TBC concrete which may be due to the presence of fine particles like fly ash and silica fume in TBC.

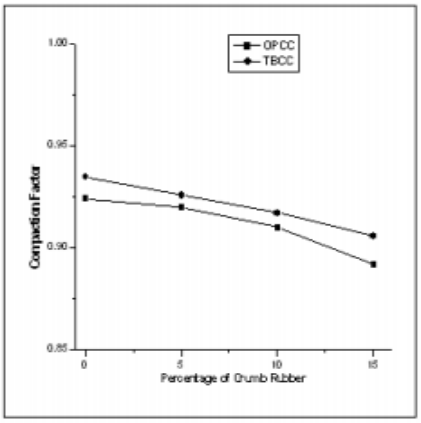

Fig.2.1. Variation of Workability of Fresh Concrete Due to the Addition of Crumb Rubber

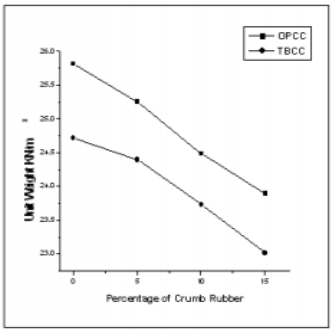

Fig 2.2. Variation of Density of Fresh Concrete Due to the Addition of Crumb Rubber.

Compressive Strength:

Compressive strength decreased as the percentage crumb rubber increased in both OPC as well as TBC concretes. The maximum loss in compressive strength at 7 days and 28 days are 20 and 32.5% respectively in OPC when 15% of crumb rubber is used. The maximum loss in compressive strength at 7 days as well as at 28 days is about 37% in TBC when 15% of crumb rubber is used. But the reduction in compressive strength of concrete at 28 days age with 5% of crumb rubber is only 15.9% in OPC and 12.7% in TBC. The strength reduction may be attributed to the entrapped air which increased with the rubber content. Also, during the vibration of concrete samples, rubber particles move toward the upper surface of the mould resulting in a high concentration of rubber particles at the top layer of the specimens. This is due to the lower density of rubber materials compared to the other ingredients of the concrete. Thus, nonuniform distribution of rubber particles at the top surface and the entrapped air might contributes to the reduction in strength.

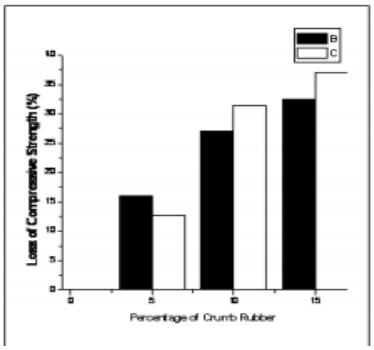

Fig.2.3. Percentage Loss of Compressive Strength of OPCC and TBCC Due to the Addition of Crumb Rubber at 28 Days

III. CONCLUSION

The Conclusion is introduction of crumb rubber into fresh concrete decreased the workability of concrete marginally and also the compaction factor was decreased as the percentage of crumb rubber increased in all concrete mixes. The low specific gravity of the crumb rubber in concrete resulted a decrease in the unit weight of the concrete by. 2.16% for 5% addition of crumb rubber, by 5.15% for 10% and by 7.43% for 15% compared to ordinary Portland cement concrete. There is a marginal reduction in compressive strength with 5% addition of crumb rubber in ordinary Portland. cement concrete and ternary blended cement concrete. Compressive strength drops drastically when the crumb rubber content increases beyond 5% and the concrete becomes unfit to be used in structural elements. There is a tremendous increase in the impact energy of crumb rubber concrete compared to plain concrete. Though there is a decrease in compressive strength by about 10 to 15%, the increase in impact strength is 100% in case of concrete with 5% crumb rubber for both OPCC and TBC. By visual observation during experimentation, it was found that the crack widths in crumb rubber concrete. Less compared to concrete without crumb rubber in both ordinary Portland cement concrete and ternary blended concrete. In a country like India, scrap tyres can be easily incorporated in concrete as a construction material. vibration damping is required such as foundation pads for machinery, and runways and taxiways in the airport.

IV. REFERENCES

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